CLAIMS

1. An autonomous subsurface drilling device for drilling in a borehole comprising:

(a) a pair of spaced-apart forward and rearward "feet" sections coupled by an axial thruster mechanism between them that can expand and contract along a main axis of the device to allow the feet sections to grip the borehole wall and alternately move the forward feet section forward and pull up the rearward feet section using an inchworm method of mobility;

(b) at least a front drill section having a drill head for cutting into the borehole and conveying cuttings along the main axis of the device to an on-board depository for collecting the cuttings, so that cuttings do not have to be passed to the surface while the device is in operation deep below the surface.

2. An autonomous subsurface drilling device according to Claim 1, wherein said feet sections of the device each employs a scroll drive unit which spins about the axis of the device in order to extend and provide radial thrust to the feet for gripping the borehole wall.

3. An autonomous subsurface drilling device according to Claim 1, wherein said axial thruster mechanism is composed of tandem sets of thrusters, one of said thruster sets being used to advance the front drill section, and the other thruster set being used to advance the forward feet and to contract the rearward feet section forward.

4. An autonomous subsurface drilling device according to Claim 3, wherein said tandem sets of thrusters allow both feet sections to be locked onto the borehole wall while the front drill section is being extended for drilling.

5. An autonomous subsurface drilling device according to Claim 1, further comprising a central spine tube to which all elements of the drill are either directly fixed or on which they are supported through linear bushings.

6. An autonomous subsurface drilling device according to Claim 5, wherein said central spine tube is arranged to convey cuttings from the front drill section to a cutting depository bin located in a rearward section of the device.

7. An autonomous subsurface drilling device according to Claim 6, wherein said front drill section is comprised of a main, larger-diameter drill head and an inner, smaller-diameter drill head positioned coaxially within a center opening of the main drill head, wherein said inner drill head is driven by an auger shaft disposed within said central spine tube extending lengthwise along the axis of said device from said front drill section to said depository bin, and wherein cuttings from said main drill head are conveyed toward said auger shaft of said inner drill head and conveyed through said central spine tube to said cutting depository bin.

8. An autonomous subsurface drilling device according to Claim 7, wherein said coaxial drill heads are driven by respective drives independently of each other.

9. An autonomous subsurface drilling device according to Claim 8, wherein said coaxial drill heads are driven in opposite rotational directions, so that torque induced on said device is reduced by the difference between each drill head's torque reaction.

10. An autonomous subsurface drilling device according to Claim 8, wherein said coaxial drill heads are driven to rotate at different rotational velocities, in order to minimize vibration and heat generation.

11. An autonomous subsurface drilling device according to Claim 7, wherein said

auger shaft of said inner drill head has a spiral fluting on its external surface for conveying cuttings through the spine tube, and said main drill head has an internal fluting in its surfaces around its center opening which is shaped to convey cuttings from said drill head toward the center of said drill head where they are collected and conveyed by the fluting on the auger shaft of said inner drill head to said depository bin.

12. An autonomous subsurface drilling device according to Claim 5, further comprising a steering mechanism provided with said rearward feet section to allow small corrections to the drilling direction to be made as drilling commences.

13. An autonomous subsurface drilling device according to Claim 12, wherein said steering mechanism is composed of an inner eccentric ring rotatable relative to an outer eccentric ring, said inner eccentric ring being rotatably coupled between said outer eccentric ring and said central spine tube, such that when said rings are rotated in opposition, said central spine tube is aligned with the direction of said rearward feet section, and when said rings are rotated in tandem, said central spine tube is aligned with a small eccentric correction from the direction of said rearward feet section.

14. An autonomous subsurface drilling device according to Claim 1, wherein power is supplied to said device through a power cord tether connected to a supply source on the ground surface.

15. An autonomous subsurface drilling device according to Claim 14, wherein a tether reel is provided on the ground surface to reel the tether in and out to said device.

16. An autonomous subsurface drilling device according to Claim 1, wherein power is supplied to said device by a power unit carried onboard with the device.

17. An autonomous subsurface drilling device according to Claim 1, further comprising a science instrument section carried onboard said device.

18. An autonomous subsurface drilling device according to Claim 17, wherein said science instrument section includes a submersible sensor package on a tether for sampling underground water or fluid.

19. An autonomous subsurface drilling device for drilling in a borehole comprising:

(a) a pair of spaced-apart forward and rearward "feet" sections coupled by an axial thruster mechanism between them that can expand and contract along a main axis of the device to allow the feet sections to grip the borehole wall and alternately move the forward feet section forward and pull up the rearward feet section using an inchworm method of mobility;

(b) forward and rearward drill sections carried respectively on said forward and rearward "feet" sections for drilling into material in the borehole in forward and rearward directions, whereby the device can maneuver in either direction underground.

20. An autonomous subsurface drilling device according to Claim 19, wherein said forward feet section is advanced in the forward direction and said forward drill section drills into the borehole while said rearward feet section is locked onto the borehole wall, and conversely said rearward feet section is advanced in the rearward direction and said rearward drill section drills into the borehole while said forward feet section is locked onto the borehole wall.

21. An autonomous subsurface drilling device according to Claim 19, wherein power is supplied to said device through a power cord tether connected to a supply source on the surface of the ground.

22. An autonomous subsurface drilling device according to Claim 19, wherein

power is supplied to said device by a power unit carried onboard with the device.

23. An autonomous subsurface drilling device according to Claim 19, further comprising a science instrument section carried onboard said device which probes radially toward the borehole wall from the axis of said device.

24. An autonomous subsurface drilling device according to Claim 19, wherein said forward and rearward "feet" sections are provided with large "snowshoe" feet for gripping onto the borehole composed of soft material.